

Fines Generation in DCU-Operation

CONTENT

CONTENT 1

1 INTRODUCTION 2

2 METHODOLOGY – PARTICLE SIZE AND FINES DETERMINATION 2

3 CASE STUDY IN COOPERATION WITH CLIENT 2

Example interpretation 3

Key observations from the chart..... 4

4 IMPORTANCE OF PROPER CUTTING TOOL..... 5

5 RESULTS..... 6

6 CONCLUSION..... 6

7 EXAMPLE PICTURES 7

1 INTRODUCTION

In the coking industry, fine generation refers to the production of small particles, typically in the size range of **<0.5 mm to 6 mm**, which are generally considered low-value or waste material. These fines are predominantly generated during the delayed coking process and should be minimized, as they negatively impact product value, handling, and overall unit efficiency.

Although fines are often observed in downstream systems, their origin is closely linked to the conditions under which coke is formed, stressed, and initially broken within the coke drum. Key factors such as feedstock quality, furnace operation, cutting practices, and overall operational control play a decisive role in determining coke structure and its tendency to generate fines.

The objective of this case study is therefore to identify the main sources of fines generation within the coking process and assess their relative contribution, with particular focus on the coke drum stage. In addition, the study aims to evaluate the role of ECHO within this context, examining how it may influence fines formation in this context.

2 METHODOLOGY - PARTICLE SIZE AND FINES DETERMINATION

Particle size distribution (PSD) and fines content are determined using standardized sieve analysis.

A representative petroleum coke sample is mechanically sieved through a series of calibrated screens with decreasing mesh sizes. The material retained on each sieve is weighed, and the particle size distribution is expressed as the **cumulative mass percentage passing** each sieve size relative to the total sample mass.

3 CASE STUDY IN COOPERATION WITH CLIENT

The Figure 1 illustrates the particle size distribution of petroleum coke measured at two locations in the DCU solids handling system:

- **Before Crusher** (orange curve): coke discharged from the coke drum prior to size reduction.
- **After Crusher** (blue curve): coke downstream of the crusher, prior to slurry basin transfer.

The PSD is presented as **cumulative mass percentage passing**.

Example interpretation

- At 25 mm, a cumulative passing of 65% (After Crusher) indicates that 65% of the coke mass consists of particles smaller than 25 mm.
- At 3 mm, a cumulative passing of 14% (After Crusher) indicates that 14% of the total coke mass consists of fines (<3 mm) at this location.

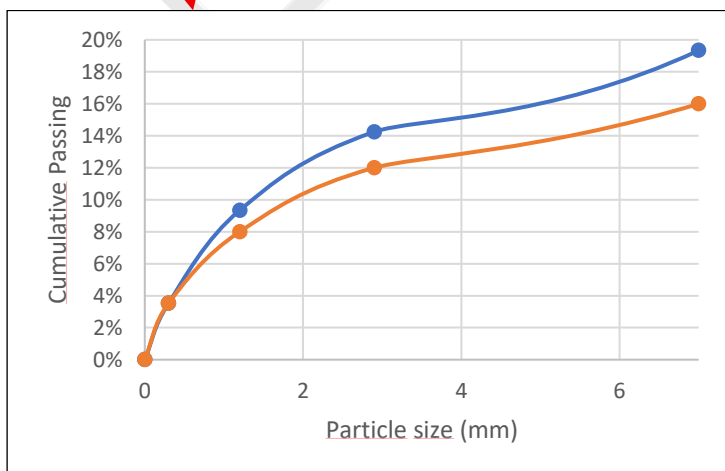
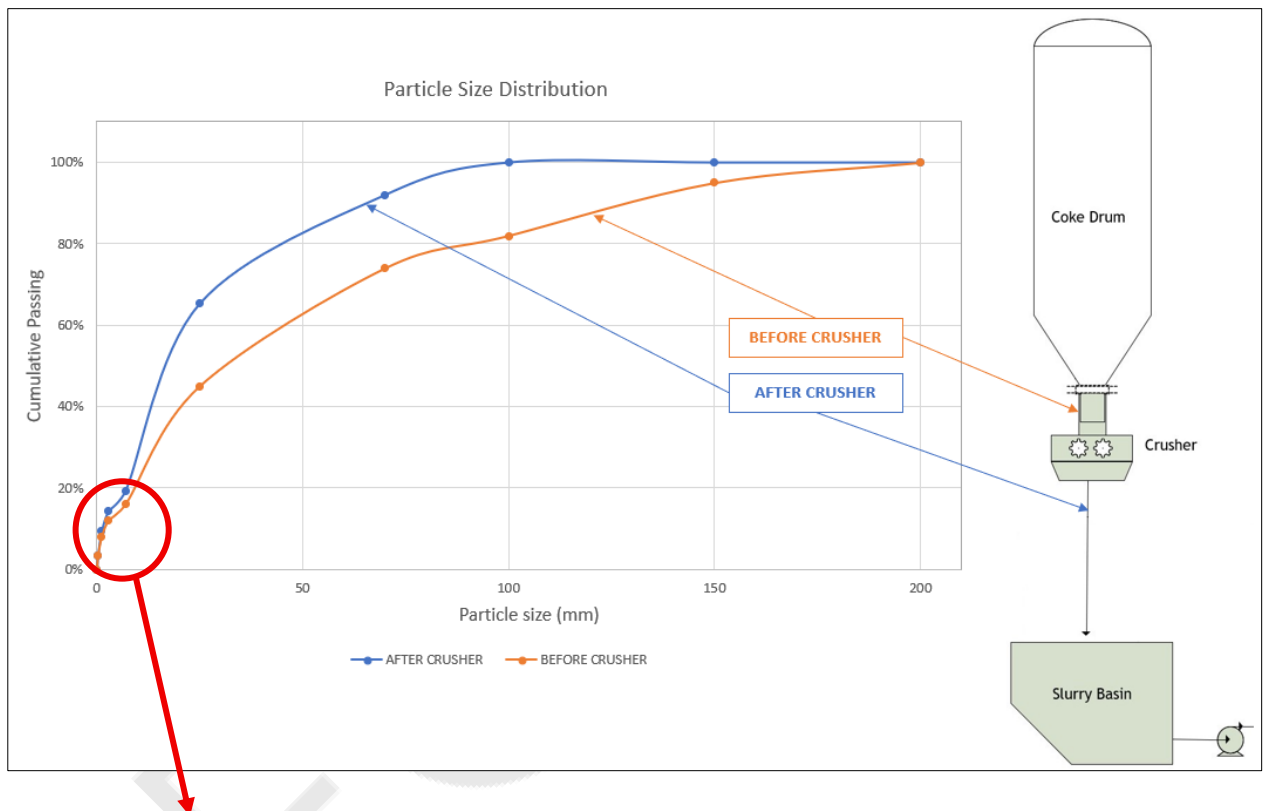


Figure 1 Diagram Fines Production in ECHO

The objective of this test was to quantify both the fines content present within the ECHO system and the extent to which fines are generated by it. To achieve this, a defined quantity of coke was sampled during the production cycle (upstream of the crusher), and an equivalent sample was taken from the dewatering bin (downstream of the rotating equipment).

Key observations from the chart

1. Overall effect of crushing

The “After Crusher” curve lies consistently above the “Before Crusher” curve, indicating effective size reduction and redistribution toward smaller size fractions.

2. Top size control

Both curves reach 100% cumulative passing at approximately **150–200 mm**, demonstrating effective control of the maximum coke particle size and the absence of significant oversize material.

3. Mid-size material generation

The largest separation between the curves occurs in the **25–70 mm** range, confirming that crushing primarily converts large coke pieces into usable mid-size fractions rather than excessive fines.

4. Fine particle content (<6 mm)

The relatively small separation between the curves below **6 mm** indicates that the crusher contributes only a limited incremental increase in fines, reflecting controlled breakage rather than attrition-dominated crushing.

5. Dust formation (<0.3 mm)

At very fine sizes (<0.3 mm), both curves converge at very low cumulative mass percentages, indicating minimal dust generation and negligible impact of the crusher on airborne or slurry-related fines.

Overall, the PSD demonstrates effective mid-size generation with controlled fines production, supporting reliable downstream handling and compliance with fines-related specifications. This indicates that the amount of fines generated within the ECHO system is negligible, and that the majority of fines are already present before the coke enters the system.

BASED ON THAT FACT, WE GUARANTEE LESS THAN 2.9 % FINE GENERATION IN THE BATTERY LIMITS OF ECHO

4 IMPORTANCE OF PROPER CUTTING TOOL

The following comparison illustrates the impact of cutting tool design and jet quality on coke fragmentation.

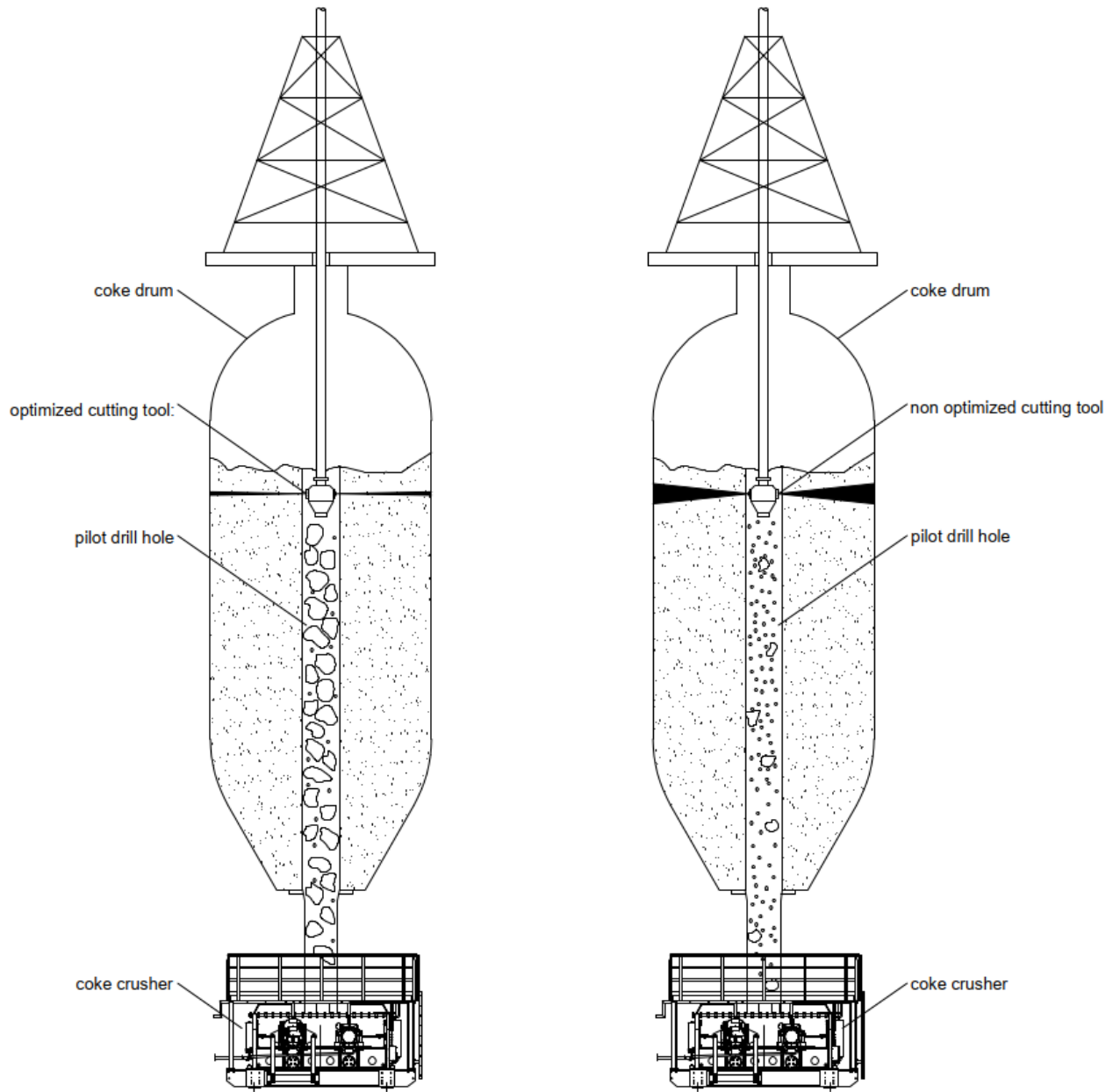


Figure 2: Effects of jet quality on fines generation

On the left, optimized cutting using a customized tool with high-quality nozzles and proper calibration produces a focused, coherent jet with minimal spreading, resulting in clean cuts and reduced fines generation.

On the right, a non-optimized system shows a widely dispersed jet, caused by unsuitable nozzles or poor calibration, which leads to inefficient cutting, increased coke breakage, and significantly higher fines production.

5 RESULTS

The formation of coke fines is closely linked to feed quality and operating conditions within the DCU itself:

- **Feedstock Quality:** High asphaltene, metals and heavy residue feeds (vacuum residue) tend to form hard, brittle "shot coke," with more porous structure which breaks into smaller pieces and generates fines during cutting, unlike spongy coke.
- **Furnace Operations:** Inadequate heater velocity or improper temperature control can lead to increased thermal cracking (overcracking). This leads to highly porous and low-density coke. Such coke has poor mechanical strength and fractures easily.
- **Cutting:** Proper coke cutting relates to the drum diameter in conjunction with a customized cutting tool or suitable nozzles that prevent the jet from spreading along its length. The spreading produces fine particles, as well as poor cutting technique increases fragmentation.
- **Operational Control:** Proper management of recycling ratios (usually < 1.27:1) and coke drum velocity is crucial to minimizing the amount of heavy material that turns into coke fines.

6 CONCLUSION

Coke fines in a DCU are primarily generated within the coke drum and during decoking because the key factors that determine coke strength and integrity act at this stage. Feedstock quality (high asphaltenes, metals, and residues) and furnace operation (overcracking due to poor temperature or velocity control) already produce porous, brittle coke that is predisposed to break into fines.

Additionally, improper cutting practices can directly fragment this weak coke, while suboptimal operational control (e.g., high recycle ratios or low drum velocities) further increase the formation of fine-producing structures.

By the time coke leaves the drum, its structure and fines content are largely established, so downstream equipment contributes only marginally to additional fines generation.

7 EXAMPLE PICTURES



Figure 3 Coke pit without Crusher



Figure 4 Coke after Crusher with ECHO